

Energy Policies to promote Renewable Energy Technologies; Learning from Asian Countries Experiences

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Abstract

The limitation of conventional energy sources in one side and environmental issues in the other side have led to countries attempt to promote renewable energy technologies. Energy policy tools have a crucial rule in deploying innovation and cost reduction in renewable energy production. Different countries have implemented various policies to promote renewable energy technologies such as: capital subsidies, feed in tariffs, tradable certificates, and renewable portfolio standards. However effectiveness of some policies is more than others. Learning from advanced countries experiences and combination with indigenous factors will help other countries to develop renewable energy technologies in energy supply structure. Current paper will analyze the effect of different policy tools in countries renewable energy sector.

Keywords: feed in tariffs, renewable portfolio standards, innovation, renewable energy policy

Introduction

In the recent decades Asian countries have experienced a rapid economic growth rate and their need for secure energy sources is becoming more important due to this economic growth. The lack of fossil energy sources in these countries and environmental issues have led to their tendency to use renewable energy sources such as solar, wind and tide energy. Meanwhile these countries have good potential to use renewable energy sources. Some of them benefit from strong wind stream and the others benefit from sun rays. However development of renewable energy technologies encounters some problems.

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The main barrier for renewable energy development is the high production cost. The production cost of renewable energies like solar and wind energy still remains higher than conventional energy sources. In this regard government's effective policy can deploy innovation and cost reduction as a consequence of innovation. Different policy tools like feed in tariffs, tradable certificate, renewable portfolio standards, tax incentives, production quotas have crucial role to promote innovation in renewable energy technologies.

Considering the importance of these policies in this paper we will compare the effects of various policy tools on renewable energy development among selected countries. We selected two Asian countries including Republic of Korea, and People's Republic of China as our case studies even though some policy tools are in initial stages in these countries and it's early to evaluate the effectiveness of such policies. We added two advanced countries including Germany and United Kingdom to our case study.

At first step case study of some selected countries including South Korea, china, UK and Germany will be evaluated and after identifying their advantages and system failures the results will be compared and finally a comprehensive pattern will be developed for other countries.

Figure 1 shows current situation and projected renewable energy share in the year 2020 among these countries. As it has been shown in the figure china and Korea are planning to increase renewable energy share to 15% and 11% respectively by 2020.

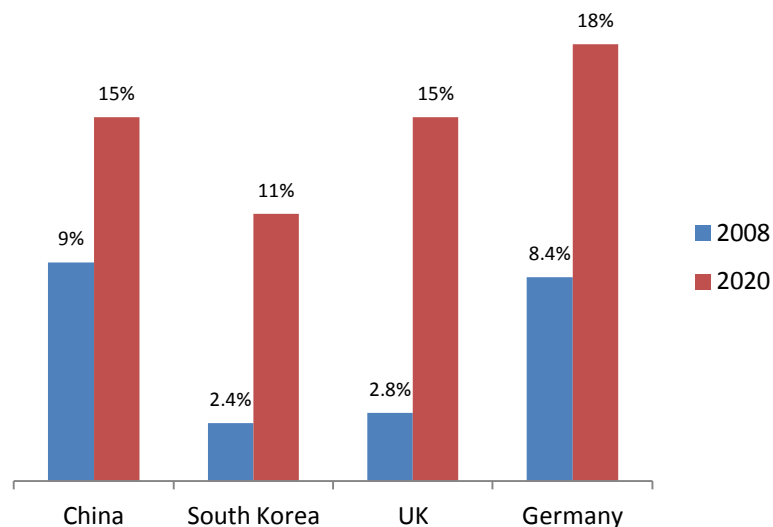


Figure 1: share of renewable energy in selected countries total energy consumption

Energy Policies for renewable energy technologies in selected countries

1- Republic of Korea

Korean government new energy policy is based on less dependence to fossil energies. Renewable energy share in Korea's total energy consumption in the year 2008 was 2.4% and Korean government by implementing different policy tools is planning to increase this amount to 11 percent in the year 2020.

The first renewable energy policy was introduced in Korea in 1980 and the government started to give incentives including low interest loans and tax exemption to renewable energy generators. General subsidy program was established in 1994 and according to this promotion act Korean government subsidized renewable energy facilities installation costs. Local renewable energy deployment program was started in 1995 and it required local governments to use a certain amount of renewable energy in public buildings and in remote area residents. In 2004 all public buildings with more than 3000 square meters required to use renewable energy as a portion of their energy consumption. This act revised in 2011 and extended to the buildings with more than 1000 square meters area (Korea Energy Economics Institute, 2011).

The first feed in tariffs law was passed in 2006 and government covered the price difference between renewable energy cost and electricity market price. Feed in tariffs contracts duration was between 15 to 20 years from the first date of subsidization. According to the reports total of 345 MW has been subsidized as of 2006.

The renewable portfolio agreement (RPA) was implemented in 2006 and its main content was voluntary agreement between Korean government and large public utilities to invest 737 million dollars in renewable energy technologies. Also first Renewable portfolio standard (RPS) was introduced in second basic plan for renewable energy deployment in 2003 and in third basic plan for Renewable energy in 2008. The starting year is 2012 and this act will obligate all electricity suppliers to produce a certain portion of electricity by renewable energy. This portion will be 2% in 2012 and will increase to 10% in 2022.

Table 1: South Korea renewable energy policy history

Year	Legislation	Notes
1987	Promulgation of The Promotional Act of NRE Development	Legal basis for NRE R&D activities
1998	Promotional Act of NRE Development, Utilization and Deployment (1st Amendment)	Amendment for legal basis for NRE dissemination
2002/3	Promotional Act of NRE Development, Utilization and Deployment (2nd/3rd Amendment)	Obligation on public bldgs (const. cost), certification, FIT
2003	The 2nd National Basic Plan for NRE Technology Development & Deployment	10 year plan, target: 3%(2006), 5%(2011)
2004	Promotional Act of NRE Development, Utilization and Deployment (4th Amendment)	Including standardization, RESCOs. etc.
2008	The 3rd National Basic Plan for NRE Technology Development and Deployment	Target: 2020(mid), 2030 (long), NRE industry promotion
2009/10	Promotional Act of NRE Development, Utilization and Deployment (5th Amendment)	RPS: 2012(2%) and 2022(10%) Obligation on public bldgs (load)
2011	The 4th National Basic Plan for NRE Technology Development & Deployment (underway)	The 2nd National Energy Basic Plan NRE industrialization, Export

(Source: Korea Energy Economics Institute, 2011)

2- China

China with dramatic economic growth rate in recent decades has become one of the hugest energy consumers and greenhouse gas producers in the world. This high economic growth and energy consumption rate required their government to implement new energy policies to promote renewable energy technologies. Nowadays main support mechanisms which provided by Chinese government are: price incentives, subsidies, tax incentives. These policy tools have led to significant progress in china's renewable energy technology promotion in recent the recent years.

The renewable energy policy in china has different types. Some main policies are in country level and legislate by central government and some policies are passed in local and regional level. First renewable energy incentives started by government by subsidizing biogas for rural areas. Also this kind of subsidies was extended to small hydro power systems in rural areas in 1980 and for wind power development in 1987. Also environmental concerns have led to enactment of new policy in 1990 with focus on wind and solar energy. The price policy act was passed in 1994 and required electricity network companies to purchase renewable energy electricity with higher price and reasonable benefit from renewable energy

generators. The electricity law in 1995 and air pollution prevention law in 2000 were another acts which encouraged renewable energy usage.

Until the year 2000 they tried to catch up advanced countries and after that they had great progress in innovation in renewable energy technologies. After that the renewable energy promotion act was passed in 2003. The other main policy was PRC law on renewable energy which had a dramatic effect on renewable electricity growth by far. Furthermore like other countries tax incentives also had a significant effect on renewable energy technologies in china. For instance the value added tax for small hydro power unit's reduced and renewable energy producers are income tax exempted. Also some parts of renewable equipments like solar power generation and wind turbines are exempted from custom duties.

Table 2: renewable energy policy types in china in the recent years

	Name of policy	Type	Target	Year
Building Integrate Solar PV Program	Incentives/Subsidies	Solar Photovoltaic	Electricity	2010
Notice on the removal of local content requirement in wind power projects equipments procurement	Policy Processes	Wind	Electricity	2009
Support for Biogas Projects	Policy Processes	Bioenergy	Electricity	2006
Wind Power Concession Program	Incentives/Subsidies	Wind	Electricity	2003

(Source: IEA policies and measures databases)

3- Germany

Like other countries Germany started to develop renewable energy technologies after oil price crisis in the mid 1970's and first incentives were provided by government to support renewable electricity generation. Until that time coal and nuclear were their main resource of electricity generation but after Chernobyl nuclear accident Germany planned to increase share of other types of energies. First support mechanisms were established in the mid 1970's and this legislation had a significant effect in increasing renewable energy share to 8.4% in the year 2008. Nowadays Germany is one the most successful countries in wind electricity generation in the world.

The first feed in tariffs law was introduced in Germany in 1990. This law required electricity distribution companies to purchase electricity produced by renewable energy sources with higher price comparing

with conventional energy sources. Feed in tariffs law had a significant effect on wind energy promotion in Germany. By implementation of feed in tariffs law wind energy production capacity increased from 20 MW in 1989 to 1000 MW in 1995. After electricity price liberalization in Germany renewable electricity generators revenue decrease due to direct relation between electricity price and feed in tariff. Finally the feed in tariffs replaced by renewable energy sources act in 2000. This new act was revised form of feed in tariffs law and it gave more grants with long term contracts to renewable electricity producers. All these policies changed Germany's situation to one of the leading countries in terms of renewable energy generation.

Table 3: Renewable Policy Types in Germany

Name of Policy	Type	Target	Status	Year
2009 Amendment of the Renewable Energy Sources Act -EEG-	Incentives/Subsidies Policy Processes	Bioenergy Geothermal Hydropower Solar Photovoltaic Wind	In force	2009 (revised 2010)
KfW-Programme Energy-Efficient Rehabilitation (Energieeffizient Sanieren)	Incentives/Subsidies	Bioenergy Geothermal Solar Thermal	In force	2009
Fifth Energy Research Programme (5.Energieforschungsprogramme - Innovation und neue Energietechnologien)	RD & D	Multiple Renewable Energy Sources	Superseded	2005
KfW-Programme Producing Solar Power	Incentives/Subsidies	Solar Photovoltaic	Superseded	2005

(Source: IEA policies and measures databases)

4- United Kingdom

First liberalization in UK electricity market happened in 1989 and nuclear energy was excluded from liberalization process. First non fossil fuel obligation (NFFO) was passed after electricity market liberalization in 1990. The main purpose of this act was supporting nuclear power and renewable energy. This act also required power distribution companies to purchase electricity produced by nuclear power plants and renewable energy. But at that time because of the importance of nuclear energy almost 90 percent of budget spent to nuclear energy development and remain for the renewable energies. In the year 1997 and after Kyoto protocol agreement UK policy changed in energy sector and in 1998 almost 50 percent of NFFO's budget spent for renewable energies (Costa 2006).

In the year 2000 a new act named utilities act was passed to support electricity market. New electricity trading arrangements in 2001 and renewable obligation (RO) in 2002 was the extensions of utilities act.

Renewable Obligation required power suppliers to produce 3 percent of their electricity in 2003 by renewable energy sources. This amount increased to 10 percent in 2010. According to renewable obligation power suppliers receive renewable obligation certificate which is tradable and can be sell to other suppliers to meet their requirements. The other extension of utilities act was climate change levy (CCL) which requires clients to pay tax for their energy, though renewable energy producers were excluded from this tax.

Table 4: Renewable Energy Policy Types in UK

Name of Policy	Type	Target	Status	Year
Energy Act 2004	Regulatory Instruments	Ocean Wind	In force	2004
Low Carbon Industrial Strategy (LCIS)	Education and Outreach Incentives/Subsidies Policy Processes Public Investment RD & D	Bioenergy Multiple Renewable Energy Sources Ocean Wind	In force	2009
Renewable Energy Strategy 2009	Incentives/Subsidies Policy Processes RD & D Regulatory Instruments	Bioenergy Geothermal Hydropower Ocean Solar Wind	In force	2009

(Source: IEA policies and measures databases)

Comparing selected countries policies

This paper reviewed consequences of different policy implications in 4 countries including South Korea, China, Germany and United Kingdom to analyze effectiveness of these policy tools. The evidences show that all of these countries started supporting renewable energy markets by capital subsidizing in early stages and feed in tariffs and renewable portfolio standards in later stages.

Table 5: renewable policy mix in selected countries

Country	Capital Subsidization	Feed in tariffs	Renewable Portfolio Standard
South Korea	●	●	
China	●	●	
Germany	●	●	
UK	●		●

Chinese government by capital subsidizing and feed in tariffs are planning to achieve targeted 27% renewable energy share in 2030. Also by implementing feed in tariffs they encourage investors to develop renewable energy in rural and remote areas in china. Similarly South Korea is providing support mechanisms to build 1 millions green homes by 2020 and their progress in renewable energy development is significant. China and South Korea are planning to implement renewable portfolio standard however feed in tariffs policies in these 2 Asian countries still in young stages and early to evaluate its consequences.

The evidences show that feed in tariffs law had significant effect on Germany's achievements in renewable technology area. Germany could achieve largest installed wind capacity in the world and largest installed PV capacity in Europe by implementing feed in tariffs policy. In the case of UK, non fossil fuel obligation and renewable portfolio standards had a crucial rule but it seems that renewable portfolio standards has less success than feed in tariffs law.

Table 6: technology and policy comparison for selected countries

Country	Main Achievements	Policy Tools
South Korea	Progress in renewable energy technology development and construction of green homes	Feed in tariffs policy has positive effect and RPs will be implemented from 2012
China	Considerable success in wind and PV installation in rural areas	Capital subsidies and feed in tariffs have been implemented and RPS is under progress to achieve targeted 27% renewable energy share in 2030
Germany	Largest installed wind capacity in the world	Feed in tariffs laws had significant effect on Germany's achievements in renewable energy technology area
United Kingdom	Significant wind installation	Renewable Portfolio Standard had a crucial rule in renewable energy development

Conclusions

Policy tools have the main role on investment level in renewable energy technologies. This research work analyzes effectiveness of various policy tools in different countries renewable energy sector. According to evidences feed in tariffs laws has the most effective role in advanced countries success in renewable energy sector. Also renewable portfolio standard is effective policy tool but its effectiveness is more tangible in mature renewable energy markets.

Renewable energy production cost still is higher than other conventional energy sources. Furthermore the governments incentives in R&D sector can promote innovation in this area and consequently cost reduction will occur in renewable energy market. These countries not only can export their technologies

but also they can share their policy experiences by making networks between their renewable energy oriented organizations.

The objective of all policy tools is lowering production cost and increasing the contribution of renewables in countries energy structure. Meanwhile longterm contracts with renewable energy generators and government commitment and control and setting longterm goals by them can help developing countries to deploy renewable energy technologies in their energy sector.

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References

1. Dominique Finon, Yannick Perez, The social efficiency of instruments of promotion of renewable energies: A transaction-cost perspective, 2005
2. Maria Silvia Muylaert de Araujo, Marcos Aurelio Vasconcelos de Freitas, Acceptance of renewable energy innovation in Brazil—case study of wind energy, 2006
3. T.J. Foxon, R. Gross, A. Chase, J. Howes, A. Arnall, D. Anderson, UK innovation systems for new and renewable energy technologies: drivers, barriers and systems failures, 2004
4. Andre´ Grimaud, Luc Rouge, Polluting non-renewable resources, innovation and growth: welfare and environmental policy, 2004
5. Robert Gross, Technologies and innovation for system change in the UK: status, prospects and system requirements of some leading renewable energy options, 2004
6. Jeffery M. Loiter, Vicki Norberg-Bohm, Technology policy and renewable energy: public roles in the development of new energy technologies, 1998
7. Claudia do Valle Costa et.al., Technological innovation policies to promote renewable energies: Lessons from the European experience for the Brazilian case, Brazil, 2006
8. Tim Foxon et.al., Overcoming barriers to innovation and diffusion of cleaner technologies: some features of a sustainable innovation policy regime, UK, 2007
9. Stefan Jacobsson et.al., The diffusion of renewable energy technology: an analytical framework and key issues for research, Sweden, 1998
10. Judith Lipp, Lessons for effective renewable electricity policy from Denmark, Germany and the United Kingdom, Canada, 2007
11. Theodoris D. Tsoutsos et.al., The sustainable diffusion of renewable energy technologies as an example of an innovation-focused policy, Greece, 2005
12. N.H. van der Linden et.al, Review of international experience with renewable energy obligation support mechanisms, United States, 2005
13. Fred Sissine, Renewable Energy Policy: Tax Credit, Budget, and Regulatory Issues, United States, 2006
14. A report for the DTI Renewables Innovation Review, Review of renewable energy development in Europe and the US, Imperial College London, October 2003
15. Peter M. Connor, UK renewable energy policy: a review, UK, 2003
16. P.D. Lund, Effects of energy policies on industry expansion in renewable energy, Helsinki University of

Technology, 2009

17. Nick Johnstone et.al. Renewable Energy Policies and Technological Innovation: Evidence Based on Patent Counts, August 2009
18. Qiang Wang, Yong Chen, Barriers and opportunities of using the clean development mechanism to advance renewable energy development in China, Renewable and Sustainable Energy Reviews, 2010
19. Li Junfeng, Zhu Li, Hu Runqing, Zhang Zhengmin, Shi Jingli and Song Yangin, Policy analysis of the barriers to renewable energy development in the People's Republic of China, Energy for Sustainable Development, September 2002
20. Feng Wang, HaitaoYin, ShoudeLi, China's renewable energy policy: Commitments and challenges, Energy Policy, 38(2010)1872–1878, 2010
21. Gao Xinyu, Jin Bo, Li Bina, Study on Renewable Energy Development and Policy in China, Energy Procedia 5 (2011) 1284–1290
22. Judith A. Cherni, Joanna Kentish, Renewable energy policy and electricity market reforms in China, Energy Policy 35 (2007) 3616–3629
23. Zhang Peidong, Yang Yanli, Shi jin, Opportunities and challenges for renewable energy policy in China, Renewable and Sustainable Energy Reviews 13 (2009) 439–449
24. Renewable Energy in China, Renewable Energy Policy in China: Financial Incentives, National Renewable Energy Laboratory
25. Jong-dall Kim, Renewable Energy in South Korea: Solar City Daegu's Challenge, Research Institute for Energy, Environment and Economy, Kyungpook National University, 2003
26. Kyung-Jin BOO, Policies and Challenges of NRE Utilization in Korea. Korea Energy Economics Institute, 2011
27. Sanghoon Lee, New and Renewable Energy Policy in Republic of Korea, Climate Change Research Center Sejong University, Korea, 2010
28. Karlynn Cory, Toby Couture, and Claire Kreycik, Feed-in Tariff Policy: Design, Implementation, and RPS Policy Interactions, National Renewable Energy Laboratory, 2009